**Center for Independent Experts (CIE) Independent Peer Review Report**

# Independent Peer Review of the Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 with Projected Annual Catch Limits Through 2016

**Honolulu, Hawaii. December 9-12, 2014**

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## Executive Summary

The quality of the input catch data and CPUE index of abundance for the stock assessment were highly uncertain and as a result I conclude that the stock assessment had serious flaws that compromised its utility for management. I conclude that the proposed generalized production model may not be appropriate for the species, fisheries, and available data if the generalized shape parameter cannot be reliably determined, which is often the case. The efficacy of the approach should have been simulation tested. The Bayesian production model suggested that stock has been less productive since the 1970s than indicated by the deterministic production model but this was not accounted for in setting benchmarks or in stock projections. I conclude that the science reviewed is not the best available.

## Background

The *Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through* 2016 was held in Honolulu, Hawaii. December 9-12, 2014. The purpose of the meeting was to evaluate the data and assessment methods to improve the scientific basis for management. The review panel was ultimately responsible for ensuring that the best possible assessments are provided to the Western Pacific Regional Fishery Management Council (WPFMC), NMFS, and the State of Hawaii. Each reviewer was required to conduct the independent peer review in accordance with the Statement of Work (SoW) and stock assessment Terms of Reference (ToRs).

The Panel was composed of three independently appointed Center for Independent Experts (CIE) reviewers (Dr. N. Cadigan, Canada; Dr. V. Haist, Canada; Dr. P. Apostolaki, UK), and CIE appointed chair, (Dr. J. Neilson, Canada). The review was supported and assisted by Dr. G. DiNardo (Stock Assessment Program Leader, PIFSC). Assessment documents were prepared by stock assessment teams and presented by J. Brodziak (NMFS Honolulu) and A. Yau (NMFS Honolulu). The support of all of these scientists and staff to the review process is gratefully acknowledged.

The CIE reviewers were required to have excellent oral and written communication skills in addition to working knowledge in fish population dynamics, with experience in the application of stock assessment models in data poor situations sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference. Approximately two weeks before the review meeting the reviewers were given background documents and reports from the data workshop. The reviewers were required to read all documents in preparation for the peer review. During the review meeting each reviewer was required to actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks were focused on the stock assessment ToRs. After the meeting each reviewer was required to prepare an independent peer review report

formatted as described in Annex 1. Each CIE reviewer's duties were not to exceed a maximum of 14 days to complete all work tasks.

**Role of reviewer**

All assessment documents and most supporting materials were made available to me by email on 25th November. These documents are listed in Appendix 1. I reviewed these backgrounds documents. I attended the entire Panel review meeting in Honolulu, Hawaii during December 9-12, 2014. I reviewed presentations and reports and participated in the discussion of these documents, in accordance with the SoW and ToRs (see Appendix 2). I also contributed to the review panel summary report. My CIE report is structured according to my interpretation of the required format and content described in Annex 1 of Appendix 2. After the meeting I participated in email discussions and writing to finalize the review panel report.

**Summary of findings**

A brief summary of the review panels (RPs) findings is presented for each ToR, followed by my assessment of whether the ToR was successfully completed, and the strengths and weakness of the research conducted where appropriate.

As typically in a stock assessment review, the focus of my report is on the weakness of the research. However, I greatly appreciated the substantial of work conducted by the assessment team in preparation for the review panel meeting. I was impressed with the high skill level of the assessors.

In what follows, D7BC indicates *Deep7 Bottomfish Complex*.

***ToR 1. Review the assessment methods used: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data***

Peer review summary report findings

The stock assessment was based on an age-aggregated Bayesian generalized surplus production model. The Panel noted the modeling approach had process and catch error included which seemed appropriate for the stock complex. The model appears to have been appropriately applied. Of course, the method is reliable only if the catch and CPUE data are reasonably reliable. Inclusion of the production model shape parameter was appropriate for this relatively unproductive species complex, and the value estimated appeared realistic.

My additional findings

Prager (2002) concluded that "if the generalized production model with estimated shape parameter is used in stock assessment, it should be applied with skepticism and in conjunction with the more robust logistic form. Unless a good external estimate of model shape is available, the logistic model appears more suitable for routine assessment use on stocks similar to swordfish". The D7BC are probably not similar to swordfish, but nonetheless it seems likely that this is a difficult parameter to determine reliably. Brodziak et al. (2011, 2014) indicated that usually estimates of the shape parameter M for D7BC tend to be around M = 2 indicating a relatively lower productivity stock. I found this confusing because when M > 1 both Bmsy and Hmsy are greater than the Schaefer results (i.e. M=1). It does not seem reasonable to me that Hmsy should be greater than R/2 for a less productive stock. One usually expects that less productive stocks can sustain lower exploitation rates. It also does not seem reasonable that we will get Bmsy > K/2 if we were to exploit this stock in the long-term at H > R/2. For a low productivity stock I expect that Hmsy, Bmsy, an MSY will be less than the Schaefer results.

I have had additional time since the peer review meeting to consider this, and I conclude that the generalized production model may not be appropriate for the species, fisheries, and available data if the generalized shape parameter cannot be reliably determined, which often is the case.

***ToR 2. Evaluate the implementation of the assessment model: configuration, assumptions, and input data and parameters (fishery life history); more specifically determine if data are properly used, if choice of input parameters seem reasonable, if models are appropriately specified and configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.***

Peer review summary report findings

The Panel agreed that the approach for catch rate standardization in 2014 was a considerable improvement but further potential gains could be made through exploring fields in the logbook data that provide a unique vessel identifier. To improve effort measurement, the Panel recommended that the assessment team consider omitting monthly catch records that include only a single entry for the whole month. The Panel also noted that the assessment did not account for technological improvements, which was a recommendation from the CPUE Workshop (Moffitt et al. 2008). The Panel concluded that the CPUE index did not seem sufficiently reliable to use as an index of stock size for the entire assessment time-period.

The Panel was concerned that there might be bias in the pre-1990 estimates of unreported catch. The current assessment practice of allowing a ±20% range of uncertainty around annual estimates of unreported catch values may not adequately account for potential biases nor the additional uncertainty in the magnitude of unreported catch in the early part of the time-series. The Panel requested a run with a constant ratio of unreported to reported catch. The ratio was

equal to that used for unreported catches in recent years (i.e. 1.08). For this run (as was also the case with the base case run), recent exploitation rates exceeded $H_{msy}$, and the stock may be overfished contingent on the choice of natural mortality ($M$=0.25 vs 0.1).

The Panel considered that the sensitivity analyses should have included broader/less informative priors. The highly informative $P_o$ prior used in the base model did not appear to be driving the model results by itself in this specific case.

The Panel had strong reservations regarding the quality of the input catch data and CPUE index of abundance for the stock assessment. Hence, the Panel concluded that the stock assessment had serious flaws that compromised its utility for management.

My additional findings

The assessment team seemed to also have reservations about the cpue index. They suggested that in future it may be better to model cpue catchability in time-blocks. This may have substantial impact on the assessment. I expected that the behavior of the cpue index during 1949-1970 is very influential on assessment model results and changing assumptions about the catchability of the index during this period may also have a large effect on model results. There seems to be much uncertainty about data reporting and impacts on cpue standardization during this period. Prior to 2002 some of the selected monthly records could include multiple trips that are assumed to be a single trip, and therefore cpue would be over-estimated. Multi-day trips were more prevalent in 1950's and 1960's. It may be more practical to only use data post-1970's. However, cpue during this period has basically followed a "one-way trip" and such a production model may give substantially different results. I expect that such a model will be more sensitive to informative priors such as the one for $P_o$.

The magnitude of uncertainty about unreported catches seemed too low. The assessment model included uncertainty in the unreported catch which is good. However, a higher range for uncertainty, but possibly not following a Uniform distribution, may be more appropriate. It is not possible for me to be more precise about this because the methodologies used to infer unreported catch were not reviewed during the meeting although background documents were provided.

The early cpue seems less reliable than the recent cpue, but the model estimated the reverse.

The assessment model also included process errors in population dynamics which is also good. However, in the model configuration these process errors were not modelled explicitly and their posterior distributions were not provided in review documents or during the review meeting. An easy way to get some indication of the impact of the process errors is to plot the stochastic production model estimates versus the deterministic model results. I evaluated the deterministic model based only on the posterior means of the model parameters provided in Table 11 of Brodziak et al. (2014). These results were substantially different from the stochastic model (Figure 1). These results indicate the stock had higher productivity compared to the production

model during 1949-1960 but lower productivity since then. The results suggest that the process errors have high temporal auto-correlation but this feature was not included in the assessment team's model.

I conclude that the model may not be appropriately specified because it does not include temporal dependency in process errors. I concur with the panel conclusions that the input catch and cpue data do not seem sufficiently reliable to use in a production model to provide management advice. Mostly I am concerned that reasonable alternative treatments of the data and model specifications could lead to much different conclusions on over-fishing and over-fished stock status.

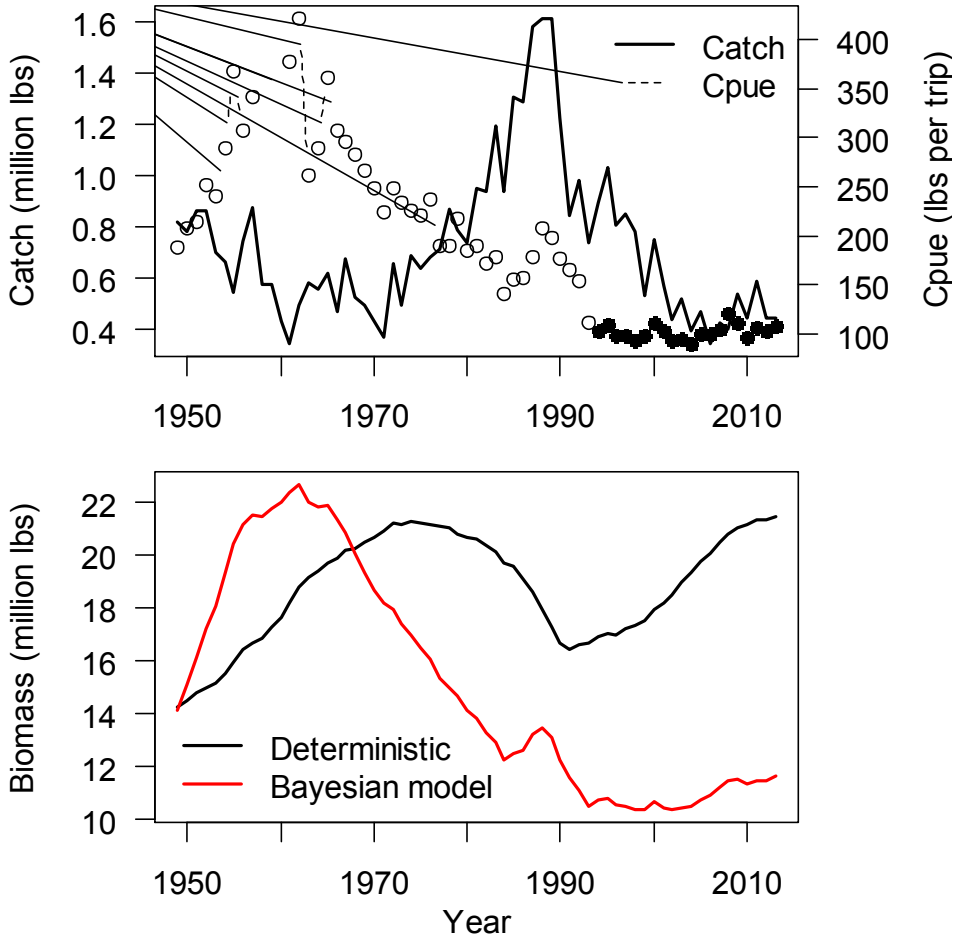


Figure 1. A comparison of the stochastic Bayesian production model estimates of exploitable biomass (red – bottom panel) provided by the assessment team and the deterministic model results (black – bottom panel) with no process errors and catch treated as fixed (top panel) using the posterior means of the production model parameters provided by the assessment team.

***ToR 3. Comment on the scientific soundness of the estimated population benchmarks and management parameters (e.g. MSY, Fmsy, Bmsy, MSST, and MFMT) and their potential efficacy in addressing the management goals stated in the relevant FMP or other documents provided to the review panel.***

Peer review summary report findings

The Panel concluded that the methodology used for the projections and establishing the targets appeared appropriate but because the stock assessment model was not credible this implied that the estimated population benchmarks and management parameters were likely not reliable for addressing the management goals stated in the relevant Fisheries Management Plan.

The Panel noted that the estimate of natural mortality ($M$=0.25) currently used to establish the overfished threshold might be too high.

My additional findings

As outlined in my response to ToR1, I find the posterior mean of 2.06 on the production model shape parameter (M) to be troubling. It implied that Hmsy is 35% higher than the Schafer model result (R/2) and Bmsy is 16% higher.

There are large differences in the stochastic Bayesian model results and the corresponding deterministic model results (Figure 1). The reference points were based on the deterministic model. However, it is known that these references points (both H and B) will be too high when there is process error. This is even moreso when the process error is auto-correlated. Recently Bordet and Rivest (2014) derived expressions for Hmsy and the mean of the equilibrium distribution for biomass when fishing at Hmsy (i.e. Bmsy) for the Pella Tomlinson model with auto-correlated process errors. We used their results to approximate the potential impact of auto-correlated process errors on reference points. Bordet and Rivest (2014) used a slightly different model formulation. Their parameter $p$ is the same as M in Brodziak et al. (2011, 2014) and their $r$ parameter is equal to $\frac{rM}{M+1} = Hmsy$ in Brodziak et al. (2011, 2014). Also, the $\sigma^2$ estimate in Table 11 of Brodziak et al. (2014) will likely be lower if auto-correlation is accounted for. I used the stationary variance, $\sigma_{st}^2 = \sigma^2(1-\rho^2)$ , when evaluating the impact of auto-correlated process error using Theorem 3.1 in Bordet and Rivest (2014). Ratios of stochastic to deterministic Bmsy and Hmsy, Bmsy($\sigma^2$,$\rho^2$)/Bmsy and Hmsy($\sigma^2$,$\rho^2$)/Hmsy, are shown in Figure 2. With no auto-correlation the stochastic Bmsy is 91% of the deterministic result and Hmsy is 85% as large. Auto-correlation increases the difference and when $\rho = 0.92$ the stochastic Hmsy is only 49% of the deterministic result. I am unsure why the stochastic reference points increase for larger values of $\rho$; however, I suspect this is not real and may be due to approximation errors in Theorem 3.1 in Bordet and Rivest (2014). Hence, these results are presented as illustrative only, but they do demonstrate the potential importance of taking stochasticity into account when deriving benchmarks.

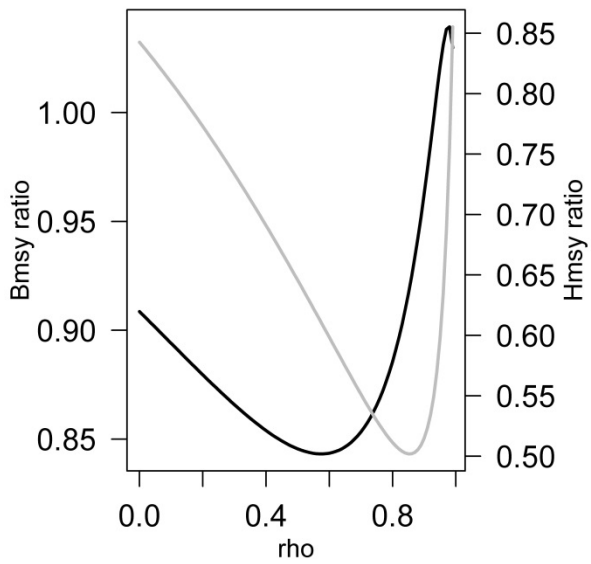


Figure 2. The ratio of stochastic to deterministic Bmsy (black line) and Hmsy (grey line) based on the production model parameters in Table 11 in Brodziak et al. (2014).

It may be that the Bayesian production model is adjusting somewhat for stochasticity. The posterior mean for Hmsy in Table 11 of Brodziak et al. (2014) is 6.6% which is lower than rM/(M+1) evaluated using the posterior means for r and M; that is, 0.11*2.06/(1+2.06) = 7.4%.

***ToR 4. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.***

Peer review summary report findings

The panel concluded that the short-term projection methodology was reasonable. It did not include temporal dependency in process errors that seemed large for this assessment; however, because the projections were only for two years, this may not be an important issue. However, the Panel considered that given the concerns with the population model identified earlier, population projections are not adequate for management purposes.

My additional findings

Surplus production models are more useful for examining loner-term trends in stock size and exploitation rates. They are very risk-prone for short-term projections without auxiliary data on recent relative recruitment (Gabriel and Mace, 1999). Hence, I conclude that the short-term projection methods may not be reliable. Nor is the approach more reliable for longer-term projections because of temporal dependency in process errors.

***ToR 5. Determine whether the science reviewed is considered to be the best scientific information available.***

Peer review summary report findings

The Panel concluded that the science reviewed is not considered to be the best available.

My additional findings

I concur because of issues outlined above.

***ToR 6. Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices. Comment on alternative data sources and modeling, including any potential fishery independent data sources that could be used to supplement fisheries data. Include guidance on single species models, and whether this is possible given the current nature of this multispecies fishery, and difficulties in partitioning fishing effort between species.***

Peer review summary report findings

The Panel considered that an immediate first priority is to strengthen the program of fishery monitoring to ensure that the collection of catch and effort data is complete and accurate. Better species-specific, spatial, gear, and size information will all be useful. The Panel recommended research continue into ways to develop more reliable stock size indices from the catch and effort data. The Panel recommends investigating the new length-frequency information from biological sampling data and new age information by completing catch curve analyses. The Panel also recommended independent evaluation of priors such as r, and values for natural mortality rate, using additional new information on the biology of the species complex.

In the longer-term, the Panel recommended continued development of the fisheries-independent surveys is critical for an improved assessment. The Panel also endorses a large-scale tagging program which can provide alternative (to the assessment model) information on harvest rates in the short-term, but notes that the design of such programs is critical to the utility of the data for harvest rate estimation. The Panel supports the intention of NMFS to move towards single species assessments, as the needed data become available to support this evolution of the assessment.

My additional findings

A tagging program does not have to be a long-term priority. A well-designed tagging program can provide estimates of harvest rates in the short-term (i.e. 2-3 years).

I don't think the panel was recommending that the single-species assessment approach be a target, but rather that species-specific information should be produced from a multi-species assessment approach. Not accounting for biological interactions between species may result in MSY reference points that are too high (e.g. Fogarty et al., 2012). Multi-species assessment models remain a challenge to implement successfully. Multi-species productions models have been investigated (e.g. Gamble and Link, 2009, 2012) but used as "operating" models and apparently not estimated from typical data.

Information was presented during the review meeting on a market sampling program that includes D7BC species. The sizes of fish are measured in this program. This information could be used, in conjunction with an estimated growth model, to provide estimates of mortality rates that are independent of the production model. This could involve methods such as the equilibrium Beverton-Holt estimator of instantaneous total mortality (e.g. Quinn and Deriso, 1999). This would also require some knowledge of the size selectivity patterns of the fishery. Recruitment variations will also violate the equilibrium assumptions but if the analyses were restricted to larger sized fish then reasonably accurate results may still be possible. A non-equilibrium Beverton-Holt estimator of Z from length data has been developed by Gedamke and Hoenig (2006). Such approaches could be used to developed an objective prior on harvest rates (assuming some value for natural mortality rate) for years with length sampling. This could be a simple improvement to the production model approach. Alternatively, the size composition information could be used with catch and cpue indices in an integrated model such as SS3; however, this may be a less simple approach.

Similarly, my understanding is that the average weight of the catch has been reported in logbook program since 1949. We did not review this information so I have no idea how reliable it is. However, if it is reliable then it could be used to infer the average length of the catch and this information could then be used to provide some information on Z's over time. This could be done in a separate analysis from the production model to provide objective priors for harvest rates for the production model, or more ideally it could be done as part of an integrated assessment model.

***ToR 7. Draft a report of the WPSAR Panel conclusions and findings, addressing each Term of Reference.***

This was completed.

**Conclusions and Recommendations**

***ToR 1. Review the assessment methods used: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data***

The stock assessment was based on an age-aggregated Bayesian generalized surplus production model. The Panel noted the modeling approach had process and catch error included which seemed appropriate for the stock complex. I conclude that the generalized production model may not be appropriate for the species, fisheries, and available data if the generalized shape parameter cannot be reliably determined, which is often the case. The efficacy of the approach should have been simulation tested.

***ToR 2. Evaluate the implementation of the assessment model: configuration, assumptions, and input data and parameters (fishery life history); more specifically determine if data are properly used, if choice of input parameters seem reasonable, if models are appropriately specified and configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.***

The Panel had strong reservations regarding the quality of the input catch data and CPUE index of abundance for the stock assessment. Hence, the Panel concluded that the stock assessment had serious flaws that compromised its utility for management.

***ToR 3. Comment on the scientific soundness of the estimated population benchmarks and management parameters (e.g. MSY, Fmsy, Bmsy, MSST, and MFMT) and their potential efficacy in addressing the management goals stated in the relevant FMP or other documents provided to the review panel.***

The Panel concluded that the methodology used for the projections and establishing the targets appeared appropriate but because the stock assessment model was not credible this implied that the estimated population benchmarks and management parameters were likely not reliable for addressing the management goals stated in the relevant Fisheries Management Plan.

I find the posterior mean of 2.06 on the production model shape parameter (M) to be troubling. It implied that Hmsy is 35% higher than the Schafer model result and Bmsy is 16% higher. Also, it seems that the stock has been less productive since the 1970s than indicated by the deterministic production model. The reference points are appropriate for the deterministic model, and may not be currently appropriate for the productivity conditions that will prevail in the next decade or so.

***ToR 4. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.***

The panel concluded that the short-term projection methodology was reasonable but given the concerns with the population model identified earlier, population projections are not adequate for management purposes.

I conclude that short-term projection methods from production models may not be reliable, nor is the approach more reliable for longer-term projections because of accounted temporal dependency in process errors.

***ToR 5. Determine whether the science reviewed is considered to be the best scientific information available.***

The Panel concluded that the science reviewed is not considered to be the best available.

***ToR 6. Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices. Comment on alternative data sources and modeling, including any potential fishery independent data sources that could be used to supplement fisheries data. Include guidance on single species models, and whether this is possible given the current nature of this multispecies fishery, and difficulties in partitioning fishing effort between species.***

*Short-term research priorities*

- Strengthen the program of fishery monitoring to ensure that the collection of catch and effort data is complete and accurate.
- Continue research into ways to develop more reliable stock size indices from the catch and effort data.
- Investigate the new length-frequency information from biological sampling and average weights of catches from logbooks, in conjunction with estimated growth curves, with a view to estimate mortality rates.

Longer-term research priorities

- The panel recommended continued development of fisheries-independent surveys.
- Provide species-specific information from a multi-species assessment approach.
- Consider implementing a large-scale tagging program to provide information on harvest rates.

**Appendix 1: Bibliography of materials provided for review**

**Documents Provided Before the Review Workshop**

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2011. Bomb radiocarbon and lead-radium dating of opakapaka (Pristipomoides filamentosus). Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822- 2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-11-07, 58 p. + Appendices.

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2012. Comprehensive validation of a long-lived life history for a deep-water snapper (Pristipomoides filamentosus) using bomb radiocarbon and lead-radium dating, with daily increment data. Can. J. Fish. Aquat. Sci. 69:1-20. doi:10.1139/f2012-109.

Brodziak, J., D. Courtney, L. Wagatsuma, J. O'Malley, H. Lee, W. Walsh, A. Andrews, R. Humphreys, and G. DiNardo. 2011. Stock assessment of the Main Hawaiian Islands Deep7 bottomfish complex through 2010. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-29, 176 p. + Appendix.

Brodziak, J., A. Yau, J. O'Malley, A. Andrews, R. Humphreys, E. DeMartini, M. Pan, M. Parke, and E. Fletcher. 2014. Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016. 59p.

Courtney, D. and J. Brodziak. 2011. Review of unreported to reported catch ratios for bottomfish resources in the Main Hawaiian Islands. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Ser., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Internal Rep. IR-11-017, 45 p.

Hospital, J., and C. Beavers. 2013. Catch shares and the Main Hawaiian Islands bottomfish fishery: Linking fishery conditions and fisher perceptions. Marine Policy http://dx.doi.org/10.1016/j.marpol.2013.08.006.

Stokes, K. 2009. Report on the Western Pacific stock assessment review 1 Hawaii deep slope bottomfish. Center for Independent Experts, stokes.net.nz Ltd., Wellington 6035, New Zealand, 27 p.

**Documents Provided During the Review Workshop**

Chen, Y. 2011. Stock Assessment of the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2010. Center for Independent Experts, 26 p.

Moffitt, R., G. DiNardo, J. Brodziak, K. Kawamoto, M. Quach, M. Pan, K. Brookins, C. Tam, and M. Mitsuyatsu. 2011. Bottomfish CPUE standardization workshop proceedings August 4-6,

2008. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Ser., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Internal Rep. IR-11-003, 17 p.

Smith, S. 2011. Report on Hawaii Deepslope Bottomfish. Center for Independent Experts. 20 p.

Klaer, N. 2011. CIE Reviewer's External Independent Report on the assessment of Hawaii deepslope bottomfish. Center for Independent Experts, 26 p.

**Documents Cited in this Report**

Bordet, C. and Rivest, L.-P. (2014). A stochastic Pella Tomlinson model and its maximum sustainable yield. Journal of Theoretical Biology 360, 46–53.

Fogarty, M. J., Overholtz, W. J., & Link, J. S. (2012). Aggregate surplus production models for demersal fishery resources of the Gulf of Maine. Marine Ecology Progress Series, 459, 247-258.

Gabriel, W. L., & Mace, P. M. (1999). A review of biological reference points in the context of the precautionary approach. In Proceedings of the fifth national NMFS stock assessment workshop: providing scientific advice to implement the precautionary approach under the Magnuson-Stevens fishery conservation and management act. NOAA Tech Memo NMFS-F/SPO-40 (pp. 34-45).

Gamble, R. J., & Link, J. S. (2009). Analyzing the tradeoffs among ecological and fishing effects on an example fish community: a multispecies (fisheries) production model. Ecological Modelling, 220(19), 2570-2582.

Gamble, R. J., & Link, J. S. (2012). Using an aggregate production simulation model with ecological interactions to explore effects of fishing and climate on a fish community. Marine Ecology Progress Series, 459, 259-274.

Gedamke, T. and J. M. Hoenig. (2006). Estimating mortality from mean length data in nonequilibrium situations, with application to the assessment of goosefish. Trans. Am. Fish. Soc. 135:476-487.

Prager, M. H. (2002). Comparison of logistic and generalized surplus-production models applied to swordfish, *Xiphias gladius*, in the north Atlantic Ocean. Fisheries Research, 58(1), 41-57.

Quinn, T. J. and R. B. Deriso. 1999. Quantitative Fish Dynamics. Oxford University Press, New York, New York. 542 pages

**Appendix 2: CIE Statement of Work**

**Attachment A: Statement of Work for Dr. Noel Cadigan**

**External Independent Peer Review by the Center for Independent Experts**

**Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016**

**Scope of Work and CIE Process:** The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

**Project Description:** A stock assessment update of the Main Hawaiian Islands (MHI) Deep7 bottomfish complex was conducted through fishing year 2013. This update used the previous benchmark assessment data analysis, modeling, and stock projection approaches with one minor improvement in CPUE standardization. This update was conducted using up-to-date re-audited bottomfish catch and effort data from Hawaii state commercial catch reports for the years 1948-2013. Unreported catch was estimated and included in the model using catch and effort data from the deep-water bottomfish handline fishery. Model selection techniques were applied to select the best structural form to standardize CPUE. An important improvement to this stock assessment model is the inclusion of information on individual fishermen's skill, or license effect, to standardize CPUE from 1994-2013; this resulted in a significant increase in the explanatory power of the CPUE standardization model but did not have a substantial effect on the estimated trend in CPUE. CPUE in the model was split into two time series (1949-1993, and 1994-2013) in order to accommodate the inclusion of license effect, which could only be tracked starting in 1994 when licenses became uniquely assigned to a fisher/vessel through time. A Bayesian production model was used to estimate time series of Deep7 bottomfish exploitable biomasses and harvest rates and was also used to conduct stochastic short-term projections of future catches, stock status conditions, and associated risks of overfishing in 2015-2016. These projections explicitly included uncertainty in the distribution of estimated bottomfish biomass in 2014 and population dynamics parameters. Results of the catch and CPUE analyses, production modeling, and stock projections are summarized and are used to characterize uncertainty of Deep7 ACLs for fishing years 2015-2016 assuming alternative commercial catch amounts in 2014. Overall, the Deep7 complex in the Main Hawaiian Islands is not currently experiencing

overfishing and is not currently depleted relative to the best available information on biological reference points.

The scientific information and assessment to be reviewed have not undergone independent peer review and there is a need to evaluate the data and assessment methods to improve the scientific basis for management. Further, the scientific information to be reviewed has a large potential impact on a valuable fishery important to commercial and recreational fishers in Hawaii and fish consumers in the state. It will be the foundation of bottomfish management decisions by the Western Pacific Regional Fishery Management Council (WPFMC), NMFS, and the State of Hawaii.

The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

**Requirements for CIE Reviewers:** Three CIE reviewers shall conduct an impartial and independent peer review as part of a panel review under the auspices of the Western Pacific Stock Assessment Review (WPSAR) process, and in accordance with the SoW and ToRs herein. CIE reviewers shall have excellent oral and written communication skills in addition to working knowledge in fish population dynamics, with experience in the application of stock assessment models in data poor situations sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference.

Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

**Location of Peer Review:** Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Honolulu, Hawaii during 9-12 December 2014.

**Statement of Tasks:** Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name,

contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/
http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review, including:

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2011. Bomb radiocarbon and lead-radium dating of opakapaka (Pristipomoides filamentosus). Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822- 2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-11-07, 58 p. + Appendices.

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2012. Comprehensive validation of a long-lived life history for a deep-water snapper (Pristipomoides filamentosus) using bomb radiocarbon and lead-radium dating, with daily increment data. Can. J. Fish. Aquat. Sci. 69:1-20. doi:10.1139/f2012-109.

Brodziak, J., D. Courtney, L. Wagatsuma, J. O'Malley, H. Lee, W. Walsh, A. Andrews, R. Humphreys, and G. DiNardo. 2011. Stock assessment of the Main Hawaiian Islands Deep7 bottomfish complex through 2010. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-29, 176 p. + Appendix.

Brodziak, J., A. Yau, J. O'Malley, A. Andrews, R. Humphreys, E. DeMartini, M. Pan, M. Parke, and E. Fletcher. 2014. Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016. 59p.

Courtney, D. and J. Brodziak. 2011. Review of unreported to reported catch ratios for bottomfish resources in the Main Hawaiian Islands. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Ser., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Internal Rep. IR-11-017, 45 p.

Hospital, J., and C. Beavers. 2013. Catch shares and the Main Hawaiian Islands bottomfish fishery: Linking fishery conditions and fisher perceptions. Marine Policy http://dx.doi.org/10.1016/j.marpol.2013.08.006.

Stokes, K. 2009. Report on the Western Pacific stock assessment review 1 Hawaii deep slope bottomfish. Center for Independent Experts, stokes.net.nz Ltd., Wellington 6035, New Zealand, 27 p.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs cannot be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: Each CIE reviewer may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

**Specific Tasks for CIE Reviewers:** The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting at the Honolulu Service Center, NOAA Fisheries Pier 38, Honolulu Harbor, 1139 N. Nimitz Hwy, Suite 220, Honolulu, HI 96817 during 9-12 December 2014, as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 2 January 2015, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Dr. Manoj Shivlani, CIE Lead Coordinator, via email to mshivlani@ntvifederal.com, and Dr. David Die, CIE Regional Coordinator, via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

**Schedule of Milestones and Deliverables:** CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

| | |
|---|---|
| 1 November 2014 | CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact |
| 21 November 2014 | NMFS Project Contact sends the CIE Reviewers the pre-review documents |
| 9-12 December 2014 | Each reviewer participates and conducts an independent peer review during the panel review meeting |
| 2 January 2015 | CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator |
| 12 January 2015 | CIE submits CIE independent peer review reports to the COTR |
| 16 January 2015 | The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director |

**Modifications to the Statement of Work:** This 'Time and Materials' task order may require an update or modification due to possible changes to the terms of reference or schedule of milestones resulting from the fishery management decision process of the NOAA Leadership, Fishery Management Council, and Council's SSC advisory committee. A request to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent changes. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on changes. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

**Acceptance of Deliverables:** Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

**Applicable Performance Standards:** The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) The CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) The CIE report shall address each ToR as specified in **Annex 2**,
(3) The CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

**Distribution of Approved Deliverables:** Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

**Support Personnel:**

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**Key Personnel:**

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## Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include the following appendices:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

## Annex 2: Terms of Reference for the Peer Review

## Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016

1. Review the assessment methods used: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.

2. Evaluate the implementation of the assessment model: configuration, assumptions, and input data and parameters (fishery life history); more specifically determine if data are properly used, if choice of input parameters seem reasonable, if models are appropriately specified and configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.

3. Comment on the scientific soundness of the estimated population benchmarks and management parameters (e.g. MSY, Fmsy, Bmsy, MSST, and MFMT) and their potential efficacy in addressing the management goals stated in the relevant FMP or other documents provided to the review panel.

4. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.

5. Determine whether the science reviewed is considered to be the best scientific information available.

6. Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices. Comment on alternative data sources and modeling, including any potential fishery independent data sources that could be used to supplement fisheries data. Include guidance on single species models, and whether this is possible given the current nature of this multispecies fishery, and difficulties in partitioning fishing effort between species.

7. Draft a report of the WPSAR Panel conclusions and findings, addressing each Term of Reference.

## Annex 3: Tentative Agenda

### Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016

Honolulu Service Center, NOAA Fisheries Pier 38, Honolulu Harbor, 1139 N. Nimitz Hwy, Suite 220, Honolulu, HI 96817

9-12 December 2014

Tuesday December 9

1. Introduction
2. Background information - Objectives and Terms of Reference
3. Fishery
    - Operation (presented by PIFSC)
    - Management (Council and PIRO)
4. Data
    - State of Hawaii System
    - Biological data
    - Other data

Wednesday December 10

5. Review of Stock Assessment

Thursday December 11

6. Continue Assessment Review (1/2 day)
7. Panel discussions (Closed)

Friday December 12

8. Panel Discussions (1/2 day)
9. Present Results (afternoon)
10. Adjourn